

- III. "Experiments on the directive power of large Steel Magnets, of Bars of magnetized Soft Iron, and of Galvanic Coils, in their action on external small Magnets." By GEORGE BIDDELL AIRY, Astronomer Royal, C.B., P.R.S.—With Appendix containing an Investigation of the Attraction of a Galvanic Coil on a small magnetic mass. By JAMES STUART, Esq., M.A., Fellow of Trinity College, Cambridge. Received January 6, 1872.

(Abstract.)

The author, after adverting to some imperfect experiments made by Coulomb in the last century, describes the apparatus which he had himself used. He employed a bar-magnet 14 inches in length, placed in one series with its edge towards the small compass on which its directive power was estimated, and in another series with its flat side towards the small compass; also a galvanic coil 13·4 inches in length, animated by a battery of three cells, and the same coil with the insertion of a soft iron coil. In the field of experiment the earth's magnetism was sensibly neutralized by external large magnets. The direction of the needle of the small compass was estimated by eye. The magnitude of the directive force was found by observing the position taken by the needle when the poles of a horseshoe-magnet were placed in a definite position above it: for the measure of the force of the galvanic coil without core, a very small magnet was used in the same manner; its power was found to be about $\frac{1}{120}$ that of the horseshoe-magnet. The circle on which the deflections were observed was graduated to cotangents, which gave immediately the measure of the force of the large magnet or coil, &c. In each case, observations were taken in 30 stations in one oval ring surrounding the magnet &c., and in 38 stations in another oval ring surrounding it at a greater distance. Omitting notice of the measures in general, the following specific points are remarked:—

At a constant distance from the steel, the greatest force exerted by a magnet is not the longitudinal force at the end, but the transversal force near the end. In going round the magnet there are six maxima and six minima of force.

The law of attraction of the core of a galvanic coil is not very different from that of a magnet.

The force produced by the core within the coil is very much greater than that produced by the coil alone. In some positions of the small compass it is about forty times as great, and in some about 170 times as great.

The law of force at different parts of the coil differs greatly from that at corresponding parts of the magnet or core. In the coil it is, proportionally, far greater at the end, and its direction is different. Near the end of the magnet or core the directions of force converge to a point within it,

distant from the end by about $\frac{1}{12}$ part of its length. Near the end of the coil, the directions of force converge to a point as exactly as possible at the centre of the end of the coil.

The author then describes the graphic process by which he has resolved the entire magnetic forces into constituent parts in the directions longitudinal and transversal to the magnet at every station, and gives tabular statements of the magnitudes of those constituent parts. A comparison is made with the results of an assumed law, but no satisfactory agreement is obtained.

An Appendix is subjoined, containing an investigation by James Stuart, Esq., of the theoretical attraction of a galvanic coil upon a small mass of magnetism, and a tabular comparison of the numerical values obtained from this investigation with the numerical values found by experiment. The agreement is satisfactory.

IV. "On a mode of Measuring the Internal Resistance of a Multiple Battery by adjusting the Galvanometer to Zero." By M. JULES RAYNAUD. Communicated by Prof. STOKES, Sec. R.S. Received January 11, 1872.

The author points out that the method given by Mr. Henry Mance for this purpose, and described in vol. xix. of the 'Proceedings of the Royal Society' (p. 252), is identical with that which he had himself previously given, and which is described in the 'Comptes Rendus' for July 22, 1867; at least the only difference is that M. Raynaud prescribes putting the poles in connexion with the earth, which of course is not necessary.

February 15, 1872.

GEORGE BIDDELL AIRY, C.B., President, succeeded by Mr. C. B. VIGNOLES (as Deputy appointed by the PRESIDENT), in the Chair.

The President, on the part of the Council, submitted to the Meeting the following Address of congratulation to be presented to the Queen:—

"We, YOUR MAJESTY'S most dutiful and loyal subjects, the President, Council, and Fellows of the Royal Society of London for improving Natural Knowledge, desire humbly to offer to YOUR MAJESTY our sincere congratulations on the restoration to health of HIS ROYAL HIGHNESS THE PRINCE OF WALES.

"Having shared in the deep anxiety of YOUR MAJESTY and the Nation whilst HIS ROYAL HIGHNESS lay prostrate under his dangerous